

85.5; West Gulf States, 81.9; Lower Lake region, 83.2; Upper Lake region, 81.8; Tennessee and the Ohio valley, 84.4; Upper Mississippi valley, 81.5; Lower Missouri valley, 80.1; Northern Pacific coast region, 78.4; Central Pacific coast region, 83.6; Southern Pacific coast region, 90.5. Of the 3,665 predictions that have been made, 132, or 3.6 per cent, are considered to have entirely failed; 109, or 3.0 per cent, were one-fourth verified; 554, or 15.1 per cent, were one-half verified; 526, or 14.4 per cent, were three-fourths verified; 2,334, or 63.9 per cent, were fully verified, so far as can be judged from the tri-daily weather maps.

Cautionary Signals.—192 Cautionary Signals were displayed during the month, of which 128, or 66.7 per cent, were justified. 96 Cautionary Off-shore Signals were displayed, and of these 92, or 95.8 per cent, were justified as to direction; 80, or 83.3 per cent, were justified as to velocity. Of the Cautionary Off-shore Signals 50 were changed from Cautionary. 288 signals of both kinds were displayed, of which 208, or 72.2 per cent, were fully justified. The above does not include signals ordered at 47 display stations, where the velocity is only estimated and not measured. 84 cases were reported of winds of 25 miles or over where signals were not ordered.

NAVIGATION.

Stage of Water in Rivers.—In the table on the right-hand side of chart No. III are given the highest and lowest readings of the Signal Corps river gauges for the month, with the dates. The Missouri rose above the danger point at Omaha on the 9th. Excepting the Savannah and Red, the rivers reached their lowest points at or near the close of the month.

Ice on Lakes, Rivers, &c.—*Missouri*—Ft. Hale, Dak., 14th, first steamboat passed up river. *Red River of the North*—Ft. Pembina, Dak., ice breaking up and moving; 12th, river free of ice; 14th, first steamer passed the fort going south. Pembina, Dak., 2nd, teams continue to cross on the ice; 3d, rapid rise in river; 8th, ice moving; 10th, ice moved out, but gorged one-fourth mile below station; 11th, ice gorge moved out; 12th, navigation opened, much floating ice; 13th, first boat of season departed; 19th, first boat of season arrived. *Mississippi*—St. Paul, 21st, first steamboat arrived. *Hudson*—Albany, N. Y., 1st, schooner arrived from New York city, first through boat of season; 2nd, river clear of ice; 4th, first passenger boat from New York city. *Connecticut*—Lunenburg, 25th, ice passed out. *Kennebec*—Gardiner, Me., 3d, ice broke below bridge and moved down about forty yards; 5th, river clear for one mile below bridge; 10th, river open, having been closed for nine days in April; 11th, ice came down from Augusta. *Penobscot*—Bangor, Me., 24th, ice passed out at 10 a. m.; navigation resumed. *Lake Superior*—Duluth, Minn., 28th, first boat of season departed. *Lake Michigan*—Chicago, 1st, navigation opened; 29th, first vessel arrived from Lake Huron. *Green Bay*—Escanaba, Mich., 4th, ice in bay; 11th, ice cracking; 25th, first boat of season arrived and reported having been twenty-four hours in breaking her way through the ice in the harbor; ice moving out very rapidly; navigation opened. Portage Point, four miles from Escanaba, 10th, ice moving out. *Grand Traverse Bay*—Northport, Mich., 14th, ice moving, harbor partly clear; 15th, ice all driven up the bay, harbor clear; 21st, thin ice in harbor; 26th, first vessel arrived from Chicago; 27th, second steamer arrived; 29th, first vessel from Milwaukee. *Mackinac Straits*—18th, ice broken up between old Mackinac and Mackinac Island; 21st, boats from Lake Huron can reach Point St. Ignace, the north passage being open and the shores free of ice; Mackinac Island, docks free of ice. *Lake Huron*—Alpena, Mich., 5th, first boat of season arrived; 11th, Thunder Bay river clear of ice. Port Huron, 3rd, steamer "Milton D. Ward" made first trip from this port, being first vessel out on the lake, navigation opened. *St. Clair River*—Port Huron, 10th to 15th, river full of floating ice. *Detroit River*—Detroit, 1st, floating ice; 2nd, first steamer left for Cleveland. *Lake Erie*—Toledo, Ohio, 6th, first boat of season arrived. Propeller Enterprise, at Buffalo 24th, from St. Clair river 19th, reported lake almost free of ice until within a few miles of Buffalo, when an immense field of rotten ice was encountered. Buffalo, 26th, ice in bay too solid for vessels to force their way through to the lake. *Niagara River*—Buffalo, 5th, river frozen over; 7th, river open; 16th, floating ice; 22nd, much floating ice, first steamer of season arrived; 26th, ice drifting in a compact field across the entrance of the harbor, completely obstructing navigation. Ft. Niagara, 28th, 29th, 30th, floating ice in river. *Welland Canal*—St. Catharines, Ont., 21st, water let into canal. *Lake Ontario*—Oswego, 9th, first vessel of season arrived; 14th, first vessel of season departed. First steamer of season down the lake from Kingston to Cape Vincent on the 19th, 41 days later than last year. Madison Barracks, 9th, loaded teams crossed bay on the ice; 15th, last team crossed; 26th, bay clear of ice, navigation open. *Lake Champlain*—West Charlotte Vt., 9th, teams crossed ice, which had continued for 53 days; 19th, ice moving a little; 23rd, ice moving with north wind, lake has been covered with ice for 81 days; 24th, ferry boats crossed. Burlington, Vt., 23rd, ice breaking up; reference to records extending over a period of sixty years shows but one other instance where the lake remained so long closed as this year; 24th, first boat of season crossed lake. Plattsburg Barracks, 27th, 28th, ice disappeared. *St. Lawrence River*—Montreal 16th, ice moving; 23rd, channel free of ice, steamer left Boucherville for Montreal. Quebec, 16th, first outward-bound steamer left port. *Magdalen Islands*—28th, steamer "Albert" arrived at Pictou, bringing first mail of season from these Islands, reports winter moderate, field ice left early, and very little ice to be seen in the Gulf.

High Tides.—Cape Lookout, N. C., 10th, 19th; Atlantic City, N. J., 18th, flooding meadows, and submerging about six miles of telegraph line. Barnegat, N. J., 17th. Gloucester, Mass., 18th, two tidal waves, first at 12:30 p. m., and the second at 4 p. m., raising water along the wharves about two and one-half feet; vessels aground. Indianola, 23rd, 24th, tide flooding streets to an average depth of ten inches; in lower portion of town water 2 feet deep. Galveston, 23rd.

Change of Channel in Missouri River.—On the 12th the bar on Yankton side of channel appeared to have increased during late rise, and steamers were compelled to finish loading nearly a mile below city.

TEMPERATURE OF WATER.

The *temperature of water*, as observed in rivers and harbors, with average depth when observations were taken, are given in table on chart No. II. Observations were interrupted at the following places on the dates indicated: on account of ice, noticed under navigation, at Alpena, 1st to 10th; Buffalo, 5th and 6th; Burlington, 1st to 23rd; Detroit, 1st; Escanaba, 1st to 25th; Marquette, 1st to 21st: water too rough, at Cleveland on the 3rd, 4th, 10th, 11th, 15th and 17th; loss of thermometer at Augusta, 29th and 30th, at Galveston, 7th to 30th, Toledo 26th to 30th, and San Francisco, 1st to 30th. Reports to hand since printing of table: Norfolk, max. temp., 63°; min., 48°; depth, 22 feet. Punta Rasa, max. tem., 80°; min. tem., 70°; depth, 12 feet.

ATMOSPHERIC ELECTRICITY.

Thunder-storms.—1st, Pa., Tex., La., Ala., Tenn., Ga.; 3rd, Ohio, Nev.; 4th, Tenn., Cal., Col.; 5th, Col., Neb.; 6th, Kan., Neb., Ark., Dak., Ill., Ia., Mo., Neb., Cal., Ind. Ty., Tenn.; 7th, Ala., Ga., Mo., Cal.; 8th, Ala., Kan., Mo., Neb., Ind. Ty., Tex., Dak.; 9th, Ill., Ind., Ia., Ky., La., Miss., Mo., Tenn., Tex.; 10th, Ala., Fla., Ia., Can., Md., N. C., Ohio, Pa., Va., W. Va., Ga.; 11th, Kan., Ohio; 12th, Col.; 13th, Kan., Ky., La., Miss., Mo., Ohio, Tex.; Cal., Ind. Ty.; 14th, La., Utah, Ala., Fla., Ga., Ill., Ind., Kan., Ky., Mo., N. C., Ohio, Tex., Col., Tenn.; 15th, Va., Ala., Ill., La., Md., Miss., N. J., N. C., Ohio, Pa., Tenn., Tex., Fla., Ga., N. J.; 16th, Ga., Ala., Fla., Ia., Miss., N. C., Pa., Tenn., Tex., La., S. C.; 17th, Ga., Fla., N. C., Pa., Va., S. C.; 18th, N. C.; 19th, Idaho; 20th, Kan., Neb.; 21st, Tex., Kan., Neb., Dak.; 22nd, Kan., Tex., Ind. Ty., Dak.; 23rd, Neb., Kan., N. J., Tex., Ind. Ty.; 24th, Kan., Wis., Ind. Ty., Tex.; 25th, Ark., Fla., Ind., Kan., Miss., Ohio, Tex., La.; 26th, Can., Fla., Ia., La. Miss., Mo., Ohio, Tex., Col.; 27th, Ga., Fla., Ill., Kan., N. C., Ohio, Pa., Tex., Col., Ind. Ty., Ia., Mich., Wis., N. Y.; 28th, Kan., N. Y., Can., Fla., Mass., Mo., Neb., N. J., N. C., Pa., Va., Miss., Ala.; 29th, Mass., Neb., Wy. Ty., Conn., Ind., Kan., Mich., Mo., N. C., Col., Ga.; 30th, Neb., Ark., Kan., Mass., Mo., N. J., N. C., Cal., Col., Ind. Ty., Tex., Va.

Auroras.—2d, Nora Springs, Ia.; 7th, Fallsington, Pa.; 8th, Starkey, N. Y., Fallsington, Pa.; 11th, 12th and 13th, Mt. Forrest, Can.; 14th, Pembina, Alpena, Eastport, and Mt. Forrest, Can.; 19th, Eastport, Bangor, Gardiner, Orono and Portland, Me., Burlington, Woodstock, West Charlotte and Newport, Vt., Springfield, Westborough, Waltham and Rowe, Mass., Southington and New Haven, Conn., Freehold, South Orange, Atco, Moorestown, Linden, Somerville and Princeton, N. J., Woodstock, Md., Catawissa, Pa.; Starkey Hector, North Volney, Waterburgh, Albany, Oswego, Rochester, Buffalo and Erie, N. Y., Mt. Forrest, Can., Ruggles, Ringgold and Cleveland, Ohio, Riley, Ill., Cresco, Ia., Alpena, Mich., Beloit, Embarrass and Manitowoc, Wis., Duluth, Minn., and Pembina, Dak.; 20th, Cornish, Me., Mendon and Fall River, Mass., Contoscookville, N. H., Ardenia, N. Y., Woodstock, Vt., and Wautoma, Wis.; 23rd, Ardenia, N. Y.; 25th, Woodstock, Md.; 26th, Clarksville, Tex., Cambridge, Mass., regularly looked for at 8 p. m.; none seen at that time; 19th, between 8 and 9 p. m., auroral light seen between the clouds; suspected on the 20th at 9 p. m.; cloudy on 3rd, 4th, 5th, 7th, 10th, 11th, 13th, 15th, 17th, 18th, 19th, 25th to 29th; some clouds, 2nd, 14th, 24th; moonlight, 1st, 2nd, 6th, 30th.

Telegraphic Communication Interfered with by Atmospheric Electricity.—Santa Fe, N. Mex., 15th, 17th and 22nd; Colorado Springs, Col., 11th; Pike's Peak, 23rd; Fort Sill, Ind. Ty., 8th, communication stopped and instruments cut out; Umatilla, Or., 30th; Cape Hatteras, 10th, 16th, 18th, 30th; Mason, Tex., 15th; Pembina, Dak., 8th.

Ground Currents.—Pike's Peak, 10th, line heavily charged.

OPTICAL PHENOMENA.

Solar Halos.—1st, Ala., Neb., Ohio. 2nd, N. C., Ga. 3rd, Ga., Cal., Utah. 4th, Mont., Tex., Mich., Mass. 5th, Mich., Ohio. 6th, Ind., Ohio, Mich. 7th, Ind., Conn., Mich., N. J., Ohio, Pa. 8th, Iowa, Mo., Minn. 9th, Ind., Nev., Mont., Ohio, Mich., N. H., N. J., N. Y. 10th, Fla., Minn., Me., N. H. 11th, Dak., Minn., Neb. 12th, Ill., Ind., Ia., Utah, Tex., Wis., Minn., Ohio, Mich. 13th, Iowa, Ohio, Me., Mass., N. H., N. Y. 14th, Ohio, Conn., Miss. 16th, Ill., Ind., Tex., Mo., Ohio, N. J., Pa. 17th, Ia., Ohio. 18th, Cal., Utah, Nev., Ia., Ga., Mo. 19th, Ia. Mich., Ohio, N. Y., Pa. 20th, Ala., Ind., Ia., Fla., Mo., Ohio, N. C., Mich., N. Y. 21st, Ia., Conn., N. J., N. Y. 22nd, Me., Mich. 23rd, Conn., N. Y., Me., N. H., N. Y. 24th, Minn., Conn., Mo., Neb., N. Y., Pa. 25th, Conn., Ind., Minn., N. Y., Me., Mass. 26th, Miss., Iowa, Minn., Tenn., Mich. 27th, Ia., Minn., N. C., Ga., Va., N. Y., Pa. 28th, Cal., Ia., Tenn. 29th, Ia., Minn., Ohio, Va., Mass., N. H., N. J., N. Y. 30th, Conn., Ia., Ohio, Mass., Miss., N. J.

Lunar Halos.—1st, Col., Ohio, Md., Mo., Neb., Va., Vt. 2nd, Neb. 3rd, Cal., Utah, Nev., Idaho, Dak., Mich., N. J., Ga., N. H. 4th, Conn., Ind., Neb., Kan., Tex., Miss., Mich., Ohio, Mass., Ga. 5th, Ind., Col., Wis., Tenn., Kan., Mo., N. J., Ga., N. H. 6th, Ia., Dak., Va., Ga., N. H. 7th, Dak., Minn., Wis., W. Va., Mich., Mo. 8th, Ind., Miss., Wis., Tenn. 9th, Ind., Tex., Me. 10th, Wis., Mass. 12th, Tenn. 17th, Dak. 18th, Ohio. 22nd, N. Y. 23rd, Wis. 24th, Mass. 25th, Ind., Minn., Tenn., Ohio. 26th, Iowa, Mo., Kan., Mich. 27th, Iowa, Ind. Ty., Dak., Mo., Mass., N. Y., Pa., Va., N. C. 28th, Ill., Nev., Dak., Kan., Mich., Ind., Tenn., N. Y., Ohio, Va. 29th, Ill., N. M., Kan., Tex., Minn., Wis., Tenn., Mo., N. Y., Ga. 30th, Utah, Nev., Ind. Ty., Tex., Ind., Me., Mich., Mo., Va., Ga., N. H., Conn., Mass.